

SCIENCE.

FRIDAY, JANUARY 9, 1885.

COMMENT AND CRITICISM.

IN ANOTHER part of this number, Professor Hilgard takes exception to our views of the proper functions of agricultural experiment-stations, as stated some weeks ago. Yet "to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions," is precisely what we understand to be the object of experiment-stations. The question simply is, How shall such scientific aid be best afforded? Shall the experiment-station seek to reach an *empirical* solution of one problem after another as it may be presented to it, or shall it search into the elementary conditions of the most important of those problems, and thus endeavor to work out a *rational* solution? The view which we hold, and which seems to be indorsed by the paragraph we quoted in our comments of Dec. 5 from Director Sturtevant's report, is that it should do both; proportioning the amount of the two kinds of work according to the necessities of the particular case, but endeavoring to do as much work of the kind last mentioned as possible. We believe that work of the latter class should be held in the higher esteem, and that the constituency of the station should, if possible, be brought so to regard it, because its results are of vastly more permanent value. We do not hold that it should necessarily, or even usually, be placed first in the order of time, or that it should ever become the exclusive work of any public experiment-station.

Our suggested differentiation of agricultural experimentation would proceed upon a somewhat different basis, giving to the experiment-station proper the working-out of scientific results (empirical or rational, as the case may be), and to the experimental farm the verification

of these results under the actual conditions of farm practice. We do not deny the advantages of uniting these two kinds of work in one institution when possible; but the men who combine the high scientific attainments and thorough acquaintance with practice necessary for the direction of both kinds of work are rare, and are likely to be rare for many years to come. We therefore hold, that, when such a man cannot be secured and kept as director, the disadvantages of segregation will be less than the disadvantages of having either the scientific experiments, or the verification in practice of their results, undertaken by incompetent hands. The separation would be in management, not necessarily in either time or space. There appears to us to be comparatively little danger that the work of American experiment-stations will be too rigidly scientific, and too far removed from the apprehension of farmers. There is a constant pressure upon a station for immediately useful results, and any station refusing reasonable conformity to it will not enjoy a long life. On the other hand, there is danger that this pressure for immediate and striking results may lead to a neglect of the scientific functions of such an institution.

THE SECOND series of the *Johns Hopkins university studies in historical and political science*, being the twelve numbers for 1884, is just completed; and Dr. Adams, its editor, may congratulate himself on his continued success in grouping together the monographic essays of the younger school of historical writers, who are arrayed under his supervision, and bow to one of Freeman's characteristic utterances, that 'history is past politics, and politics is present history.' These papers evince a new school of historico-political students, who carry antiquarianism beyond a dry assortment of agglutinated facts, and humanize it by connection with social development. The study of institutional and economic history,

in its direct connection with social progress, brings with it an urgent plea for recognition as conveying into the study of the past a good deal of that critical spirit and close observation which have made the laboratory and the closet twin arenas. In its reaction from the broad generalization, and the rotund expression which was so easily generated out of the now antiquated method, there is some danger, it is true, of the magnifying of minuteness beyond its inherent deserts; but it seems quite clear that the hither following upon the thither swing of the pendulum will bring a rest within a happy mean. The experiment is going on successfully, and every one interested in the orderly arranging of historical results will watch its further progress with interest.

THERE ARE sceptics among scientific men as well as among other professional men; and we have no desire to plead extenuating circumstances in favor of those so-called scientific men who claimed that steam-navigation would be a failure, or that ocean-telegraphy would be impossible. The believer in the truth of alleged psychical phenomena must encounter scepticism, and the newly formed psychical society must expect to receive many suggestions of doubtful expediency from both the learned and the unlearned. What no man knows, even the uneducated and untrained can pretend to know. The time may come when it will be not unusual to study 'veridical phantasms' by polarized light, and to observe their behavior in a magnetic field. What the result will be to physical science, it is difficult at present to perceive. It is not difficult, however, to conceive of a great influence upon imaginative literature. Why should not a devotee of psychical research add another scene to Hamlet, in which is displayed a psychical laboratory, with rows of bottles labelled 'reagents for ghostly odors,' 'tests for fragments of bogies,' and 'supersensual platform scales'? In the midst is Hamlet testing the kingly ghost. A favorable analysis would go far to explain the strength of Hamlet's convictions, which

have so long been a deep study to psychologists.

Considering the renewed interest in archeological investigation, is it not surprising that there should not be an archeological psychical society, — a society, which, in place of exhuming relics of other civilizations, should endeavor to get closer to the primitive state of man by trying psychological investigations upon Eskimo, natives of central Africa, or the denizens of King Prester John's dominions? The complicated civilization of to-day is fast destroying these more or less original types. If the physicians of the time of Chedorlaomer had taken careful measures of the physical dimensions of the giants of those days, and had made experiments upon their appetites and their sense of color (which, of course, must have been enormous), we should have had accurate data in physiology and psychology, which could compare favorably with that we have in archeology.

An accurate study of a pure African's nervous organization, of his instincts, his sense of color, his hypnotic conditions, his reasoning powers in general, must be taken now, or the world will soon lose forever the opportunity. The steam-engine and the telephone will soon change the sable athletic rover of the underwoods to that higher state of civilization which, it is true, obliterates all those fine instincts we also had once in common with our animal ancestors, yet gives us in return nervous prostration, and the ability, it may be, to smell ghosts. Here is a great field of investigation, for the neglect of which our descendants will bitterly reproach us. If we are in search of a name, we might term the subject to which we desire to call the attention of the Psychical society, 'Darwinian psychology.' Is it not reasonable to suppose, that, by careful and systematic observations on young Eskimo and young Africans, we can gain a knowledge of still more primitive men, who, alas! are now only 'veridical phantasms'?

In physics, Fourier's theorem enables us, from certain measurements of temperature, to determine what will be the probable heat of the earth some time in the future. What we need in psychology is a psychical theorem, retrogressive in its character. The surroundings of man daily grow more varied; and his resemblances to his animal ancestors, it is claimed, are fast disappearing. Now is the time to sound a warning note. Our original psychical sources are disappearing. Instead of weighing a lusty African who will tip the scales at a hundred kilograms, we shall soon be reduced to weighing 'veridical phantasms' which we suppose must be below a fraction of a milligram. Back to the original sources, say we! This is the cry of all scholars, and psychists can form no exception to the general rule.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The functions of experiment-stations.

REFERRING to the editorial comments on this subject in the issue of *Science* of Dec. 5, I cannot omit to interpose a demurrer to what appears to me to be a somewhat narrow view of the proper functions of experiment-stations in this country, and one which, if understood to be the prevailing one, would quickly put an end to the popular demand for the establishment of such stations, especially in the newer states.

If it is not one of the essential and primary objects of agricultural experiment-stations to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions and factors in a new country, in order to afford them relief from the slow tentative process of blind experimenting by which the solution of practical questions is commonly approached, then, indeed, the *raison d'être* of such establishments will be seriously questioned in all but the older states, where the *otium cum dignitate* of purely scientific investigations can be indulged in without leaving undone things that ought first to be done.

If the experiment-stations do not do this work for the farmer, who is to do it? It is not certainly the function of the agricultural colleges as such, although in very many cases their greatest present usefulness assuredly lies in that direction; since their direct influence through the few students who hasten through a superficial course in their halls will long remain insensible, unless supplemented by such practical demonstration of the usefulness of agricultural science as the experiment-station work can afford. From both the practical and the educational point of view, then, those functions to which the article in question allots a second place, should, in my view, be placed first.

Again: it is said that to unite the two functions of an experiment-station — the scientific and the practical — in one institution and under one management is of doubtful propriety. So far from admitting this, I hold that nowhere can scientific investigation be more fruitful than where, in this direct connection with practice, it is brought face to face with new conditions, and therefore with new phases and aspects of old problems. I think it would be a grave mistake to segregate the two branches of the work, whether in space or time, and most especially to intrust the solution of practical problems to persons of inferior qualifications, as is too commonly done, to the detriment of the cause of science, and to the disgust of those engaged in pushing it in the face of the difficulties it naturally encounters in a new country. There is a limit to the usefulness of differentiation, when each of the segregated branches is thereby trimmed down to narrowness, and want of proper co-ordination with the other. In our widely varied domain, each location affords peculiar advantages for the prosecution of some branch of both pure and applied agricultural science; and those in charge of the several stations should know, or carefully consider, in which direction their greatest usefulness (in the widest sense of the word) lies.

No one narrow definition of the proper duties and functions of agricultural experiment-stations can apply to all cases alike. Each station will have to adapt its mode and scope of operations to the surrounding circumstances; and the good judgment exercised in determining these points will in a great measure determine also the scientific as well as the practical usefulness of such an establishment. With any thing like an adequate endowment, the two branches are not only compatible, but will fertilize each other, as does the combination of investigation and instruction in the case of teachers. The abstract investigator will rarely shape and express his ideas as clearly as the one who is habitually compelled to put them into the proper form for the understanding of others; and the same is measurably true of the experiment-stations, in which scientific work, and that intended for the direct instruction of the contemporary population, should go hand in hand. It does so even in Europe, where the practical questions needing determination are much fewer and less intricate; and, if it be contended that a different policy should be adopted in this country, the *onus* of showing the reasons therefor certainly devolves upon the advocates of the new doctrine.

E. W. HILGARD.

University of California.

The most economical size of electric-lighting conductors.

In *Science*, No. 97, p. 524, Professor Carhart points out an oversight of mine (No. 94, p. 477) in leaving out the cost of waste heat in the conductors as a part of the economy in the Edison three-wire system, and also a mistake in estimating its amount; in both of which I am glad to be corrected. But Professor Carhart has not, I think, quite reached the most economical result, for the reason that we have the interest on n conductors, but heat developed in *only two* of them; and, as it seems worth while to develop the complete solution for this interesting system, I further submit the following:—

Suppose the size of conductors in the two-wire system to be such that the interest on their cost equals that of the heat-energy developed in them (C^2R , using Professor Carhart's nomenclature), which, for simplicity, we will take equal to unity. The general

expressions for the various constants (in terms of those of the two-wire system), when the same plant of lamps is divided up (with n conductors, each of whose cross-sections is k times that of one of the first) into $n-1$ equally-balanced circuits, with $n-1$ dynamos in series, as in the Edison system figured on p. 477, vol. iv. (the same energy being developed in the lamps as at first), will then be:—

$(n-1)^2 \cdot r$ = the resistance of the lamps.

$\frac{R}{k}$ = the resistance of the two outside conductors.

$\frac{C}{n-1}$ = the current in the same.

$\frac{CR}{(n-1)^2 \cdot k} + Cr = E_{n-1}$ = difference of potential at terminals of each of the $n-1$ dynamos.

$\frac{C^2 R}{(n-1)^2 \cdot k}$ = heat-energy wasted in two outside conductors.

$\frac{C^2}{(n-1)^2} \cdot (n-1)^2 \cdot r = C^2 r$ = energy developed in the lamps.

$\frac{n}{2} \cdot k \cdot C^2 R = \frac{n}{2} \cdot k$ = interest on cost of n conductors.

The energy consumed in the lamps ($C^2 r$) is the same as at first, as shown by Professor Carhart, and, being constant for the plant of lamps, need not be further considered. The total running-expense, then, *due to conductors* (including interest on their cost), is

$$\frac{n}{2} \cdot k + \frac{1}{(n-1)^2 \cdot k}$$

in terms of $C^2 R$. This should be a minimum. Its first differential coefficient with reference to k , placed equal to zero, gives

$$k = \frac{1}{n-1} \sqrt{\frac{2}{n}}$$

as the most economical section. This gives, for the minimum value of the total running-expense,

$$\frac{1}{n-1} \sqrt{\frac{2}{n}} + \frac{1}{n-1} \sqrt{\frac{n}{2}} = \frac{1}{n-1} \sqrt{2n},$$

the interest and heating-cost being equal, as they should. The same value of k gives

$$E_{n-1} = \frac{1}{n-1} \sqrt{\frac{n}{2}} \cdot CR + Cr$$

as the corresponding difference of potential at the terminals of each of the $n-1$ dynamos.

Substituting now in these different expressions, and also in corresponding ones for the Edison system and for Professor Carhart's plan, values of n from 2 to 6, we have the various data given in the following table.

No. of conductors.	Cross-section of each.	Difference of potential at terminals of each dynamo.	Interest on conductors.	Heat-waste in conductors.	Running-expense of conductors.
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EDISON'S SYSTEM.

n .	$\frac{1}{(n-1)^2}$	$\frac{(n-1)^2}{(n-1)(n-1)} CR + Cr$	$\frac{n}{2(n-1)^2}$	$\frac{(n-1)^2}{(n-1)^2}$	$\frac{n}{2(n-1)^2+1}$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.250	1.000 " "	0.375	1.000	1.375
4	0.111	1.000 " "	0.222	1.000	1.222
5	0.062	1.000 " "	0.156	1.000	1.156
6	0.040	1.000 " "	0.120	1.000	1.120

PROFESSOR CARHART'S PLAN.

n .	$\frac{1}{n-1}$	$\frac{1}{n-1} \cdot CR + Cr$	$\frac{n}{2(n-1)}$	$\frac{1}{n-1}$	$\frac{n+2}{2(n-1)}$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.500	0.500 " "	0.750	0.500	1.250
4	0.333	0.333 " "	0.667	0.333	1.000
5	0.250	0.250 " "	0.625	0.250	0.875
6	0.200	0.200 " "	0.600	0.200	0.800

THE MOST ECONOMICAL PLAN.

n .	$\frac{1}{n-1} \cdot \sqrt{\frac{2}{n}}$	$\frac{1}{n-1} \cdot \sqrt{\frac{n}{2}} CR + Cr$	$\frac{1}{n-1} \cdot \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} \cdot \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} \cdot \sqrt{2n}$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.408	0.612 " "	0.612	0.612	1.225
4	0.236	0.471 " "	0.471	0.471	0.943
5	0.158	0.395 " "	0.395	0.395	0.791
6	0.115	0.346 " "	0.346	0.346	0.693

Some very interesting comparisons of relative advantages might be noted, did space permit. The most important is the rapid increase in the ratio of heat-energy to capacity of conductor in the Edison system, which might make it necessary to lay the wires so as to admit of pretty free radiation of heat.

This question of temperature of electric-lighting conductors promises to protrude itself the more they are laid underground. The desideratum for an insulating covering would seem to be a non-conductor of electricity and good conductor of heat, — apparently inconsistent qualities. Perhaps the eventual solution will be in bare or loosely covered wires on highly insulated points of support, thus admitting of free radiation of heat, like aerial lines. H. M. PAUL.

Washington, Dec. 15.

Sun-spots.

Mr. Todd, in a recent number of *Science*, speaks of Sept. 23, 1883, as the last day of that year on which

the sun was free from spots. I find that I observed the sun, for the purpose of mapping its spots, Dec. 5, at eight A. M., Washington (Penn.) local time, and it seemed to be entirely clear. The instrument used was a four-inch refractor. Thinking I might have overlooked some small ones, I observed it again with an eight-inch refractor at half-past one, power of a hundred and fifty, and did not see any spots. The contrast between the sun's face, Dec. 5, 1883, and Nov. 5, 1883, is very marked. I find I mapped seven groups on Nov. 5, 1883, one of them having eight well-developed spots.

D. J. McADAM.

Washington, Penn., Dec. 19.

On the care of entomological museums.

The editorial comments on this subject in *Science* for Dec. 19 are certainly very pertinent. For a long time I have been at work on the micro-lepidoptera of North America, until now I have by far the largest collection of the Pyralidae, Tineidae, and Pterophoridae of this country, and a collection of the Tortricidae of the world, fuller and more complete, probably, than any other in existence. My work has hitherto been, in a great measure, to get the insects authentically named by a careful comparison with the original types, in order that the collection, already so large, should prove in some sense an authoritative standard for comparison. This work has, of course, given me an opportunity of observing the condition of the types of North-American micro-lepidoptera in the collections both of this country and Europe, and the care which they have received.

In some American museums the insects are looked after by men who have to gain their livelihood in some vocation remote from the museum. The authorities of other museums have the impression that they have made adequate provisions for the preservation of their insect-collection when it is put under the oversight of an assistant, although he may have no knowledge whatever of such objects. It is not surprising that so many types are represented in these museums by a labelled pin only.

One great trouble is, that many museum officials have very little appreciation of the vast amount of labor, care, skill, and knowledge required to bring together, properly arrange, preserve, and make accessible to those who are competent, and desire to study any one or more of the insects in it, a large and varied collection. One director told me that it did not seem profitable to pay a man two thousand dollars to watch a thousand dollars' worth of insects; and yet he was not at liberty to dispose of them, so they must go to destruction.

At present I believe the museum at Cambridge is the only one in this country which gives assurance that a competent curator of entomology will always be employed; yet I think it is not provided with means to purchase collections of insects. The National museum has appointed an honorary curator; but it might as well be without any as to have one whose entire time is occupied elsewhere, for who would think of donating valuable and perishable types to a museum thus officered!

As matters now stand, it is better for those who are able to dispose of their collections without a consideration to allow them to go to the Museum of comparative zoölogy; but, if they are not able to give them, they should go into the hands of private individuals who are working on that particular class of insects. It is better for them to be sold to the European museums, where they will be preserved,

than for them to go to destruction in a museum of this country.

C. H. FERNALD.

State college, Orono, Me.

Your remarks, p. 540, in regard to the preservation of insect-collections are eminently proper and to the point, with the exception of the closing assertion, which is not justified. It is true that the curatorship of insects in the National museum is at present honorary, and that there is no paid assistant; but it is equally true, that, since my charge of that department, all collections and every single specimen received at the museum have been properly cared for; so that where, up to three years ago, nothing of the many valuable collections brought to the museum remained, there is now the nucleus of a collection; and so long as I am curator of the department, honorary merely though the position may be, no material shall go uncared for. Feeling that a beginning toward a national collection had to be made, and that the museum was the proper place for it, I have thus far given my time to this object in the belief that proper financial provision will be forthcoming for such conduct of the department as will guarantee both the preservation and the future care of collections. When such provision is made, my own private collection, and others that I know of, will be donated to the institution. Until then much valuable entomological material will naturally be lost to the capital.

C. V. RILEY.

[We neither expressed nor intended any slur whatever upon the present honorary curator of the insect-collections of the National museum. As any one can see, our remarks applied to the perpetual care of valuable collections. If they are not insured perpetual care, the less of them that go there the better. And so we repeat, that "the appointment of an honorary curator is worse than useless. It only deceives those who know no better, into the supposition that collections sent to the museum are insured proper care. They are not." We regret if the present honorary curator feels hurt by this 'closing assertion'; but it is the only logical outcome from our previous remarks, which he characterizes 'eminently proper and to the point.'—Ed.]

THE CHEMICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.

In 1876, the year in which the Johns Hopkins university was opened to students, a small chemical laboratory was built. It was large enough to accommodate about forty working students, and was well equipped with the necessary conveniences for chemical work, from the most elementary to the most advanced. In the course of a few years, temporary desks were put up wherever an available corner could be found, and finally it became evident that a larger building must be erected. Accordingly, the trustees voted to enlarge the old laboratory so as to make room for a hundred students. The work has recently been completed; and,

as the new laboratory is the result of a great deal of thought, it is believed that a brief description of it would be of interest and value to the readers of *Science*.

The laboratory adjoins the biological laboratory lately described in these pages. A space of forty feet in width separates the two buildings, securing ample light for both. The north

city, and will not be occupied by buildings. Thus from all four directions the laboratory is well lighted, and there is practically no danger that the light will be interfered with.

Entering from the street, we find ourselves in the corridor of the first floor. On the left is the gas-analysis room, so situated that the direct light of the sun cannot enter it. It is



FIG. 1.—NORTH END OF THE JOHNS HOPKINS CHEMICAL LABORATORY, FACING THE STREET.

end presents a frontage of fifty-five feet on the street. A view of the street end is given in fig. 1. It extends back from the street about one hundred feet, the back part being eleven feet narrower than the front. It is built of the finest pressed bricks, and ornamented with a bluish sandstone, and presents a handsome, substantial appearance. On the east is one of the university buildings, containing the general library. The south end receives light unobstructedly, the nearest building being somewhat more than one hundred feet distant. The intervening space is the property of the

fully equipped for all kinds of analytical work with gases. The apparatus of Bunsen, and the more rapid though less accurate apparatus of Hempel, are always ready for use. The floor, the joints of which are laid in white lead, is made of carefully selected strips, and thoroughly oiled and waxed. Further, it slants slightly from all points towards one corner of the room, where there is a box at a lower level, containing a bottle arranged so as to catch any mercury that may be spilled. Next on the left there is the photometric room. The walls of this room are black, and the windows are pro-

vided with black Venetian blinds, which, when drawn, exclude all light. The polariscope, spectroscope, goniometer, photometer, and photographic apparatus are used here.

On the right, next in order, is the first of the three large working-rooms for students, known as laboratory A. Its dimensions are thirty by

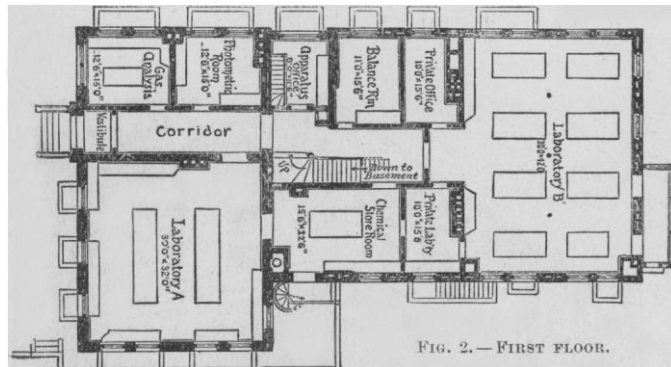


FIG. 2. — FIRST FLOOR.

thirty-two feet. The work of those who are in the earliest stages of their course is carried on here. Forty students can be accommodated in this room at one time without inconvenience. Adjoining it is a large storeroom, in which the chemicals are kept, and the solutions for the reagent-bottles prepared.

On the opposite side of the hall are the apparatus-office and a balance-room. The office is connected by a stairway with the store-rooms for apparatus, which are in the basement. All necessary apparatus is loaned to students who sign receipts for whatever they may take; and the cost price is charged for any thing which may not be returned in good condition.

Passing on, we enter laboratory B, which was the main working-room of the old laboratory. It measures thirty by forty-two feet, and has places for thirty students. Those who work in this room have had some preliminary training. They are here engaged in complicated qualitative mineral analyses, preparations, and quantitative analyses. The office and private laboratory of Associate-Professor Morse adjoin this room, and open into it.

The arrangements for sulphuretted hydrogen deserve special mention. As is well known, this valuable gas is the chief source of discomfort in chemical laboratories; and chemists will, perhaps, wonder and doubt when it is

stated, that, in the laboratory under consideration, its familiar odor is practically unknown. This desirable result is reached by providing for it, not a separate room, as is customary, but a separate, thoroughly ventilated building, immediately adjoining laboratory B, but completely isolated from it. It is provided with a high chimney, and means are taken which not only ought to, but actually do, secure a constant upward draught. It contains a large gas-generator, which furnishes sulphuretted hydrogen, and which is in charge of the janitor, who is required to see that it is kept in order. All work with noxious gases must be carried on in the 'stink-room,' under penalty of the law. The experience of the past year has been such as to lead the writer strongly to advise all who have any thing to do with building chemical laboratories to see that they are

similarly provided.

Having thus taken a hasty glance at the first floor, we may pass to the second. Here we find the main lecture-hall, with a large preparation-room opening into it. Over the lecture-table, extending nearly the entire width of the room, is a large hood of galvanized, corrugated iron. This is connected with a ventilating-flue, the opening of which is about fifteen feet

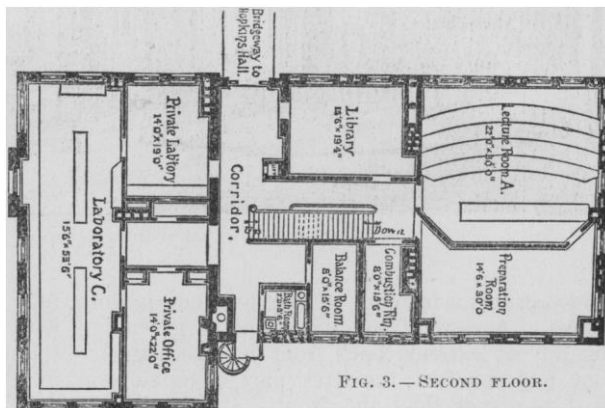


FIG. 3. — SECOND FLOOR.

long by three feet wide, extending upward through the roof. A row of gas-jets may be lighted at the lower end of this flue, thus securing a remarkably efficient ventilation. On the table there is also a closed hood, and a pipe with down draught.

The library is unusually well supplied. It

contains full sets of nearly all the important chemical journals; and all the current journals are received in exchange for the *American chemical journal*, which is published under the auspices of the Johns Hopkins university. Books may be taken out of the library by any one working in the laboratory. He is only required to sign a receipt, and leave it with one of the assistants, who acts as librarian. Notwithstanding the freedom allowed in the

The most advanced work, including the researches, is carried on here. Most of the students who occupy the places are looking forward to taking the degree of doctor of philosophy within a year or two. The instruction is under the immediate supervision of the director of the laboratory, Professor Remsen, whose private laboratory and office adjoin the room.

On the third floor the principal room is in-

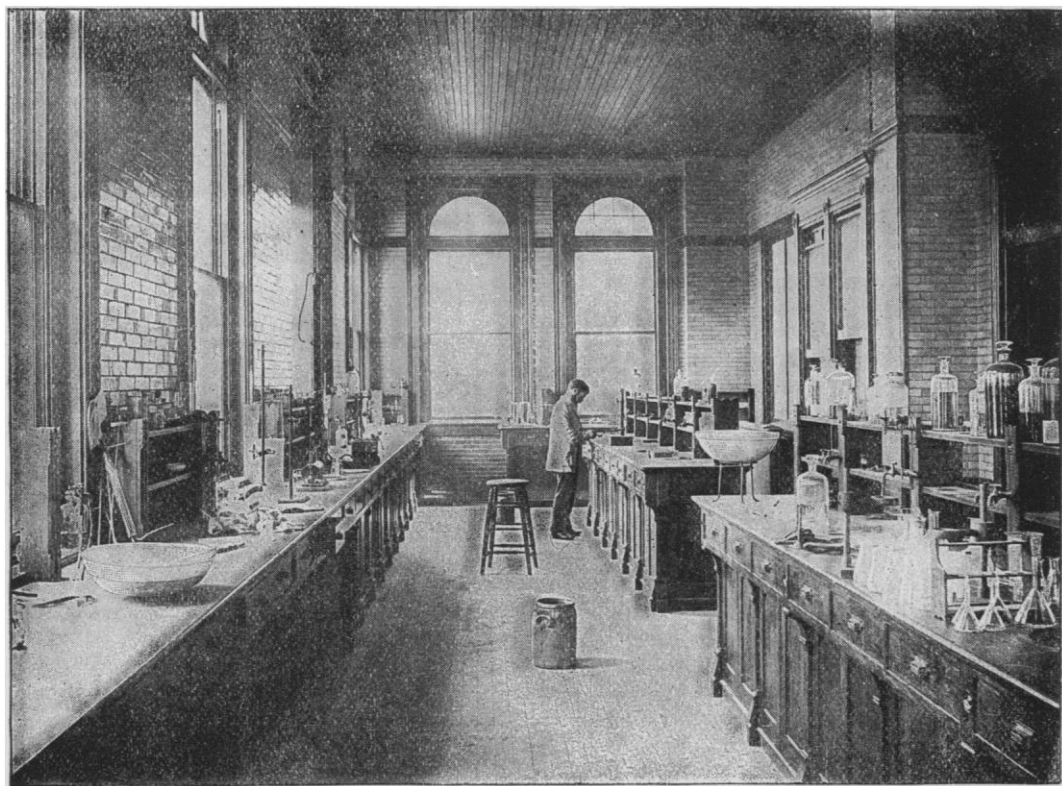


FIG. 4.—RESEARCH-ROOM IN THE JOHNS HOPKINS CHEMICAL LABORATORY.

use of the books, only one insignificant volume has been lost during the past eight years.

Passing to the north end of this floor, we enter laboratory C, or the research-room. This is well lighted by windows on the north side, as well as on the east and west. It measures fifty-three and a half by fifteen and a half feet. It is perhaps the handsomest room in the building. The walls are of cream-colored glazed bricks, the color of which is relieved here and there by a row of delicate blue. The windows are large. The table-tops are of black-walnut, the lower parts of light wood.

tended for a chemical and mineralogical cabinet. It is furnished with cases, like some of those used in the National museum at Washington. The object of the collection which has been begun is not show, but simply instruction. A curator has recently been put in charge, and it is hoped that before a great while the results of his care will be apparent. The idea which is to guide him is this: to get together good specimens of all available substances which are strictly chemical, then such minerals as illustrate the forms in which the different elements occur, and, finally, specimens

which illustrate the most important applications of chemistry to the arts. The first two classes are already well represented, and a fair beginning has been made on the third.

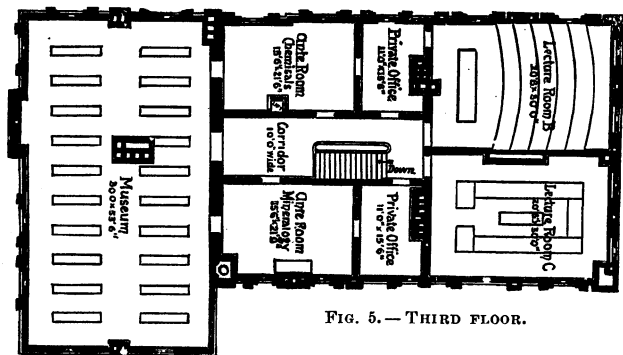


FIG. 5.—THIRD FLOOR.

It is, however, in connection with the third class that the chief additions will be made for some time to come.

On the third floor, in addition to the cabinet, there are two lecture-rooms,—one for chemistry, and the other for mineralogy,—besides two small laboratories for the examination of minerals, and the preparation of specimens for the museum.

There remains only the basement, which is well lighted, and really amounts to an additional story. It is, of course, largely taken up by storerooms and the heating-apparatus; but there are, in addition, two convenient large rooms, which have been fitted up for furnace-operations. In one of these are, among others, two smelting-furnaces of the extremely convenient form in use in the assay-laboratories connected with the U. S. mints. All the necessary conveniences for assaying ores have been secured, and it is intended that all students of pure chemistry shall at least know what assaying is. It is not proposed to go into the teaching of applied chemistry in any narrow sense, but rather "to afford the thoroughly-trained chemist an opportunity to familiarize himself with some of the more important applications of his science."

In conclusion, it should be stated distinctly that the laboratory not only works well on paper, like some of the chemical reactions which students are wont to originate, but, as a matter of fact, it has been found to be ex-

tremely convenient and practical. The flues draw in the right direction; the desks are large enough, more space being allowed each individual than in any laboratory known to the writer; the light is good; the water and gas supplies are ample: in short, no serious complaint has been made against the working of any essential feature, though a large number of students have been constantly engaged in it during the year. It is believed that in its present condition it affords facilities for every kind of chemical work. 'Conveniences' have not been unduly multiplied, as the director's experience has led him to the belief that it is possible to make a laboratory so extremely convenient that it

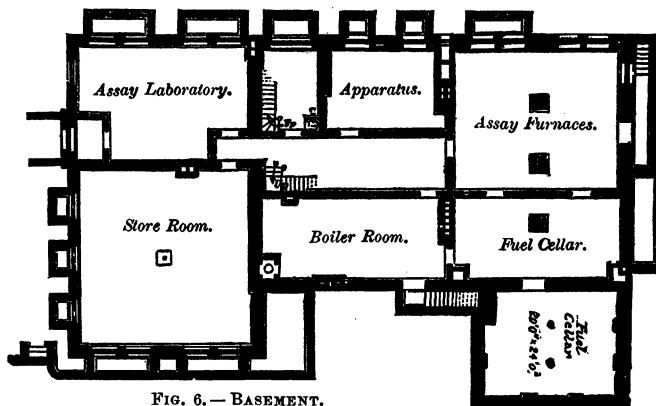


FIG. 6.—BASEMENT.

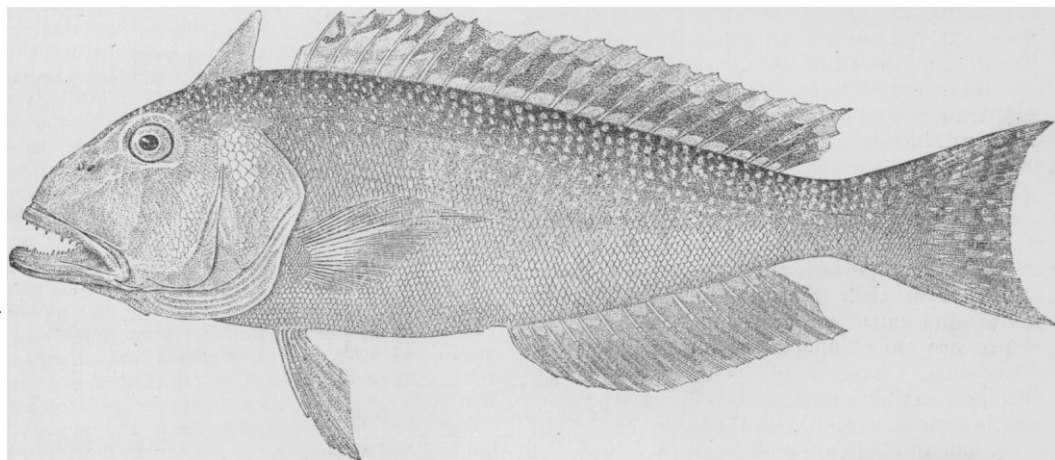
is difficult to work in it. It may safely be asserted that all really valuable forms of apparatus or arrangements for special operations have been taken into account, and embodied in the building.

THE TILE-FISH.

IN the spring of 1879 a Gloucester fishing-schooner, accidentally fishing on the Gulf-Stream slope south of New England, found in abundance a fish which later proved to be new, and was described under the name of *Lopholatilus chamaelioniceps*, but which the fishermen named tile-fish. The fish-commission later found that it possessed excellent edible qualities; and the prospect of thus adding a new fish to our east-coast food-fishes created a stir at the time. So bright were the prospects, that a fishing-vessel was even being fitted out

for the purpose of catching this new fish, when, in the early spring of 1882, reports were brought in by vessels that dead tile-fishes were seen floating in immense numbers over areas of many square miles. These dead or nearly dead fishes were floating, belly upward, all the way from off Cape Hatteras to Nantucket, and in such numbers that there were in one case estimated to be fifty in a square rod. As they weighed from five to fifty pounds, even allowing for exaggeration, the sight must have been strange. They were examined, and found to be perfectly healthy, and some were eaten. All were not dead, but some seemed to be benumbed; and, when placed in the sun on deck, they revived sufficiently to move the muscles slightly. There were some other fishes among them in

we find that there were 719,360,000 pounds of dead fish on the surface. The extreme abundance of these fishes was never imagined before their destruction. This destruction is not without parallel; for in certain bays on the coast of Labrador, when icebergs have grounded, cod have been killed in great numbers by the sudden decrease of temperature, and their bodies washed ashore. In Texas, during the Mexican war, after a very cold night, enough fishes were washed on the beaches in a benumbed condition to furnish food for Gen. Taylor's whole army. Other cases are recorded where volcanic action has caused similar destruction. Of the theories suggested to explain the destruction, all were discarded but that of cold water. Volcanic action



THE TILE-FISH.¹

a similar condition; but, as none were saved, the species cannot be identified. This great abundance of paralyzed fishes on the surface, without any apparent reason, attracted much attention, and many causes were ascribed to explain the phenomenon. The fish-commission itself made inquiries; and the following startling statistics concerning the number of dead fishes are taken from Capt. Collins's official report. They covered 4,250 square miles; and, if one-twentieth of the number recorded by the man who saw the most be taken as an average number for the area, we have a total of 1,438,720,000 fishes. Even if we allow only one fish where the observer reported 400, we still have an astounding total of 71,936,000 fishes. Taking ten pounds to be the average weight,

could not be used to explain it, because there was no disturbance; and disease would not account for the phenomenon, because all the fishes were perfectly healthy.

The tile-fish is a warm-water fish, and belongs to a family which is peculiarly a tropical group. The part of the ocean which these fishes inhabit is a portion of the rapidly sloping Gulf Stream slope. A narrow belt in this region, having a depth of from seventy to a hundred and fifty fathoms, is so influenced by the Gulf Stream as to have a nearly uniform temperature of about 50° F. the year round. On either side of this belt is one of much colder water. The inner shallow shore-water often descends in winter below 32° F., and beyond to the great ocean-depths the temperature gradually descends. This belt, being so much warmer and more uniform in tempera-

¹ Reproduced from a drawing loaned by the U. S. fish-commission, as were the cuts on pp. 337, 338, vol. iv.

ture, is, as a natural consequence, inhabited by a different fauna; in fact, by a tropical deep-sea fauna, an extension of that of the West Indies. Not only the tile-fish, but certain crustaceans, are examples of these. Naturally they would be sensitive to cold. During the spring of 1882, violent and long-continued easterly and northerly winds prevailed, and numerous icebergs stranded on the George's Banks just north of the belt. We have every reason for believing that these winds carried the inshore waters, which were naturally cold, but whose temperature had been lowered by the stranded bergs, across the border-line and into the warm area. If this were the case, such delicate animals as the tile-fish could not possibly stand the sudden change which their more hardy neighbors could easily live through. So it was that the tile-fish and a few other species were exterminated from these grounds. Although the fish-commission has organized many extensive expeditions for the sole purpose of searching after the tile-fish, not a single specimen has since been found, either of the tile-fish or the other species. Whether or not they still exist in waters more southern is an open question; but we understand that Professor Verrill believes they will be found there. At any rate, it is certain that they are entirely absent from their former haunts, and that, if they do exist elsewhere, many years must elapse ere they inhabit this bank again in abundance. Such sudden changes as these, and local extinction of several species by such simple means, cannot help throwing much light upon paleontological geology.

RALPH S. TARR.

COMETS AND ASTEROIDS OF 1884.

WHILE the year 1884 has brought no comets of remarkable brilliancy or popular interest, compared with the comets of 1881 or 1882, nearly all the comets of the year will claim more than ordinary attention at the hands of astronomers, on account of the interest which attaches to the investigation of their orbits. Of the five comets seen, four have been periodic.

The first comet which was discovered in 1884 belongs properly with the comets of the preceding year, as it passed perihelion on Dec. 25, 1883. It was discovered, however, on Jan. 7, 1884, by Ross, an amateur observer, at Elsternwick, near Melbourne, Australia, — "a faint nebulous object, with an ill-defined central condensation, and a small, tail-like projection." It was not visible in the northern hemisphere, and was under observation for only about a month. The tail was one and a half degrees long on Jan. 18, 1884.

The first comet of 1884, in order of perihelion passage, was that discovered, or rather re-discovered, by Brooks, at Phelps, N. Y., on Sept. 1, 1883. It has been commonly known as the Pons-Brooks comet, or Pons comet of 1812, having been originally discovered by Pons at Marseilles in that year. An account of this comet has already appeared in *Science* (iii. 67).

The second comet, in both order of perihelion passage and of discovery, was that found by E. E. Barnard of Nashville, Tenn., on July 16, 1884. At the time of discovery it was a nebulous object, slightly condensed near the centre, and tolerably bright. It was found to move in an elliptical orbit with a period of about five and a half years, the elements bearing a very close resemblance to those of DeVico's comet (1844, i.). The comets do not, however, appear to be identical. The nearest approach to the sun was on Aug. 16.

The third comet of 1884 was discovered on Sept. 17, by Wolf, a student at Heidelberg, and is still under observation. In its physical appearance, the comet has changed very little since discovery. As far as I know, it has not at any time been visible to the naked eye, nor has it shown any indications of a tail. When examined on Nov. 13, with the nine-inch equatorial at the Naval observatory, under a magnifying-power of one hundred and two diameters, it presented the appearance of a 'slightly oval, nebulous object.' Near the centre of the nebula was a bright disk nearly circular, and in the centre of this disk the stellar nucleus. The line of demarcation between the disk and the surrounding nebula was, of course, extremely uncertain; but measures made with the filar micrometer gave, roughly, a diameter of $1' 52''$ for the outer nebula, and a diameter of $18''$ for the central disk. Using the distances given in Krueger's ephemeris, these measures would represent distances of forty-seven thousand and seventy-five hundred miles respectively. By far the most interesting feature of the comet is its orbit. Krueger has assigned a period of about six and seventh-tenths years, but there is no evidence of any previous appearance. He remarks that at the returns in 1871 and 1878 it was unfavorably situated. In 1891 and 1864 its situation is favorable, if we can suppose that it follows the same path as at present. Krueger points out, furthermore, that in the early part of 1875 the comet must have suffered considerable perturbation by Jupiter, and before that time it may have been following an entirely different orbit. Perihelion was passed on Sept. 26.

Encke's comet, the most interesting short-period comet, has just been reported by Professor Young. It is extremely faint, but will grow somewhat brighter. It will not reach perihelion till March, 1885.

To complete the list, we should mention a 'suspected' comet to which some interest is attached. A faint, round, nebulous object was found by Spitaler with the twenty-seven inch refractor of the Vienna observatory, while searching for comet 1858, iii., on the morning of May 26, 1884. Unfavorable weather prevented a re-examination of this place till June 17 and 18, when the object could no longer be seen, nor

could it be found afterwards near its predicted place. It is still doubtful whether this was the expected comet.

During the year, ten new asteroids or minor planets have been discovered, making the total number now known two hundred and forty-five. The new-comers are as follows: (236) Honoria, discovered by Dr. J. Palisa, at Vienna, April 26; (237) Hypatia, by Palisa, June 27; (238) by Knorre, at Berlin, July 1; (239) by Palisa, Aug. 18; (240) Vanadis, by Borelly, at Marseilles, Aug. 27; (241) Germania, by Dr. R. Luther, at Düsseldorf, Sept. 12; (242) Kriemhild, by Palisa, Sept. 22; (243) by Palisa, Sept. 29; (244) by Palisa, Oct. 14; (245) by Palisa, Oct. 27 (at first taken for Andromache). W. C. WINLOCK.

FURTHER NOTES ON BOGOSLOFF ISLAND.

AN examination of the official report of Capt. Healy, Lieut. Cantwell, and Dr. Yemans, of the U. S. revenue-cutter *Corwin*, and of the drawings and photographs by which it is accompanied, affords a few further notes of interest in regard to this re-

error in earlier measurements, including *our own*; since the length of the peak, which cannot have changed much, is only about a thousand feet. The earlier estimates of the height of Grewingk were about double its real height. The tendency is always toward overestimating a height when there is nothing adjacent for comparison, and accurate measurements from on shipboard are extremely difficult. The south spit of Bogosloff has certainly increased greatly in length since recent disturbances, and now measures about eighteen hundred feet, when previously it did not exceed one-third the length of Bogosloff. The north end of Bogosloff rises nearly vertically with a sort of cave at its base. The shores of both peaks are fringed with large water-worn boulders of hard rock. The axis of the old peak and spit is in a south-east by east direction. There was not the slightest sign of recent vulcanism about it; and the crags were the haunt of myriads of birds, but too crumbling to scale. There are no birds on the new peak, and those accidentally entering its vapors are quickly suffocated. Ship Rock rises eighty-seven feet, and has been elevated about twenty feet above its old level, judging by the barnacles still clinging to its sides. The apex has crumbled a little, and is less squarely cut than formerly.



BOGOSLOFF ISLAND AND SHIP ROCK. FROM A PHOTOGRAPH BY LIEUT. G. H. DOTY, 1884.

markable island. It may be recalled that the new peak was first seen, so far as now known, by Capt. Anderson of the *Matthew Turner*, Sept. 27, 1883, and that therefore the application to it of the name of Capt. Hague, on the ground that he was the discoverer, as suggested by Lieut. Stoney, is erroneous. We prefer to retain the prior name of Grewingk, who first collected and discussed all the existing data in relation to the island and its changes.

In regard to the Bogosloff peak, the new observations determine that it contains a dike or central longitudinal wall of laminated rock, probably volcanic, of which Ship Rock may be an outlying spur. The top and ends of Bogosloff are entirely, and the sides partly, uncovered by the disintegration of a very friable rock of different character from the core. The high sharp pinnacles observed in 1873 appear to have been destroyed by the commotions attending the upheaval of Grewingk. The highest (east) point is now about three hundred and thirty-four feet, the centre two hundred and ninety feet, and the west part three hundred and twenty-four feet in height. These differ slightly from Stoney's figures, and considerably from previous measurements. Allowing for all the probable diminution in height, due to various causes, we are convinced that a large part of the discrepancy is due to

Grewingk is less sharp than Bogosloff. As nearly as could be determined through the steam-jets, the highest peak of Grewingk is less than four hundred and fifty feet, and its base is somewhat over three thousand feet long. A deep ravine which apparently represents the crater, but is too full of steam to afford a fair view, extends in a north-easterly direction through the upper third of the mass, and cuts off a peak south-east from it, estimated to be four hundred feet high and about one-fifth the volume of the whole summit. The sides of Grewingk rise with a slope varying from ten to forty-five degrees; near the base it is gentler; and the surface of soft ashes, thickly covering broken rock. The slope, after the first three hundred feet, becomes steeper, and chiefly of loosely piled rocks; at two-thirds of the total height from the base, a wall of volcanic pudding-stone checks further progress. On the north-west side many irregular rocks appear: the other sides are more thickly strewn with ashes. There is no lava. Many steam-jets are visible, but are noiseless or only purr slightly. In one place, two-thirds of the way up, there is a group of fifteen jets on a nearly horizontal plane, which were notable for the force with which the vapor was emitted, and for their intermittent regular pulsing. All the vents were surrounded with dendritic sulphur crystals.

There were but few and slight earth-trembles experienced by the party while on the island. It is quite possible that the spit now connecting the two peaks is a later formation, not existing at the time of Hague's visit. Such spits may be formed or destroyed in a single winter storm. The Corwin party, however, thought this had merely been elevated from the seabed with Ship Rock, but without the participation of the old peak. It is at present composed of fine black sand, and gray, black-spotted, water-worn pebbles, without vegetation, and may be covered with breakers during heavy storms. It is less than four thousand feet long, and about three hundred and twenty-six feet wide at its narrowest part. W. H. DALL.

THE CHOLERA EPIDEMIC IN PARIS AND IN YPORT.

WE reproduce to-day two diagrams, showing the course of the epidemic of cholera in Paris in November. They are both taken from recent numbers of the *Revue scientifique*.

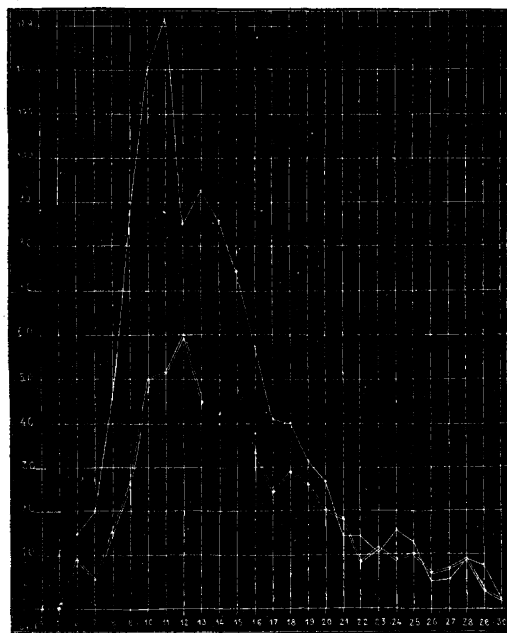


FIG. 1.

In both of them the double line is the curve of deaths; but in fig. 1 the single line is the curve of cases admitted to the hospital, whilst in fig. 2 it indicates the total number of deaths in the city and hospitals taken together.

The numbers along the foot of the diagram indicate the days of the month. The vertical columns show the number of entries and of deaths in fig. 1, and the number of deaths in fig. 2.

Examining the first diagram, we find that the first case entered the hospital on Nov. 4; that on the 5th there were ten new cases; and that the number ran up very rapidly, until, on the 11th of November, one hundred and thirty-two new cases were reported from the hospitals alone. From this date the number of cases diminished, until, on Nov. 30, there were but two new cases, and two deaths; and immediately after this the activity of the epidemic became suspended. Taking the total number of cases recorded (1,002), and comparing it with the number of deaths (573), we have a mortality of 57%,—a rather startling result, under the circumstances; for it may be taken for granted, that under the care of a hospital staff, if anywhere, the best results are to be obtained in the treatment of this disease. It may be said, and with how much truth we do not know, that only the worst cases were entered at the hospitals, and that many of these were moribund at the time of entrance. Our impression is, however, that the cases were a fair representation of the average.

This diagram presents also the usual characteristics of a cholera epidemic, the stage of increase (Nov.

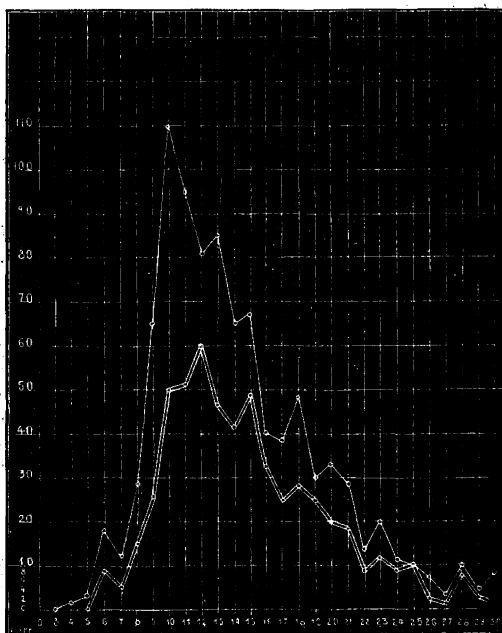


FIG. 2.

4-10), the stationary stage (Nov. 10-14), and the period of decline (Nov. 14-30). This, of course, is but a representation in miniature of what occurs in outbreaks that are spread over a greater extent of time. The suddenness of the decline of the epidemic may be due, in part, to the vigorous measures taken to stamp it out; but its disappearance is to be ascribed mostly to the frosts of the last of the month, which were frequent and rather severe.

The second diagram presents in a graphic manner the comparative rate of mortality in and out of the hospitals. From it we find that the total number of deaths from cholera from Nov. 3 to Nov. 30 was 916, and that 343 of these took place in the city at large. We regret exceedingly that the total number of cases in the city is not at hand for purposes of comparison with those in the hospitals. The question of the advantages of hospital treatment for such cases is still an open one in certain quarters, and may be settled in some measure by a study of this epidemic.

The conclusions to be drawn from the charts are that the outbreak was not an extended one, although it was widely diffused throughout the poorer parts of the city; that its virulence, as a whole, was equal to that of others, the rate of mortality being fully up to the average; and that the recent advances in sanitary science are not yet so thoroughly perfected and crystallized that their application to practical purposes produces a visible effect in the restraint of a pestilence, when occurring in a large city.

What may be done in a small community which is thoroughly under medical control is illustrated by an account, by Mr. Gibert, of an outbreak of cholera at Yport, near Havre.¹ This epidemic is as interesting and complete in its details as a laboratory experiment. The community is small and isolated, contains sixteen hundred inhabitants, and is out of the direct line of travel. The source of the disease was traced with precision to two sailors who reached the village Sept. 28. One of them had had an attack of cholera at Cette; and on the day after his arrival at Yport he soaked his soiled clothing, and hung it out to dry in front of his house, allowing the dirty water to run along the street.

From this nidus the disease started, and there occurred forty-two cases with eighteen deaths. Without following the account further, it will be interesting to read Gibert's conclusions — justifiable, apparently, from the account which he gives. They are, —

1. That cholera was brought to Yport.
2. That it was brought by insufficiently disinfected clothing, soiled by cholera dejecta.
3. That, after this clothing was washed, it became the agent of severe and rapid contamination.
4. That the cholera was propagated, by means of contagion, from house to house, without its being possible to attribute a single case to the transportation of the specific germ by the air.
5. That the sanitary measures taken, although incomplete, inasmuch as it was not possible to separate the sick from the well, were sufficient to stamp out the epidemic.
6. That the complete destruction of the cholera dejecta, and the disinfection or destruction of all effects soiled by them, seem to be sufficient to stamp out an epidemic of the disease, when it has not attained too great proportions.
7. That contagion by the air (the common acceptance of the term) appears to be an error; for at Yport three nuns and three physicians, or students in medicine, lived for a month under the most favorable

conditions for taking the disease by this channel. They all escaped, with no further precautions than taking their meals at a distance from the cholera patients, and avoiding the handling of moist and soiled clothing.

8. The question of water has no bearing in this case, for the very good reason that the Yportais never drink any.

AN AMERICAN COMMUNE.

THERE is at present a wide-spread feeling, both among scholars and men of affairs, that the time has come for an abandonment of that economic method which consisted largely in verbal quibbles and scholastic controversies about definitions of conceptions, and for a substitution in its place of a careful examination into the phenomena of this wonderful life of man in society which has received so little attention from science. The question is asked, "Why not study economic phenomena as we study the phenomena of plant or animal life?" And surely it seems as interesting and as important to observe the social life of man as that of ants in an ant-hill. It was with this conviction that Dr. Shaw undertook the preparation of this little volume on Icaria; and he was fully conscious of the fact that he was treating communism from a new stand-point, as is shown by these words taken from the preface: —

"A great number of books and articles have been written in recent years, discussing socialism and communism in the abstract; . . . and there would be no reason for the present monograph if it also undertook to enter the field of general discussion. Such is not its purpose or plan. Certainly the most common defect in the current literature of social and political questions consists in the tendency to generalize too hastily. Too little diligence is given to searching for the facts of history, and to studying with minute attention the actual experiences of men. In the following pages an attempt is made to present the history of a single communistic enterprise; . . . to picture its inner life as a miniature social and political organism; to show what are, in actual experience, the difficulties which a communistic society encounters; and to show by a series of pen-portraits what manner of men the enterprise has enlisted."

To prepare himself for his task, Dr. Shaw read the works of the French communist Cabet, the founder of Icaria, the publications of other Icarians, and passed a week with them. This volume is, then, a careful study, conducted in the spirit of modern science.

Icaria, with its romantic and interesting history, is an example of pure communism, and as such has important lessons to teach.

Icaria: a chapter in the history of communism. By ALBERT SHAW, Ph.D. New York and London, G. P. Putnam's Sons, 1884. 9 + 219 p. 16°.

¹ *Revue scient.*, Dec. 6, 1884, No. 23, p. 724.

One impression gathered from the pages of this work is the almost religious fervor with which communists are devoted to their peculiar social creeds. Ridicule is unable to turn them aside from their purposes, and repeated failure does not shake their faith. Speaking of the charms which the community at Brook Farm found in their life, and their unwillingness to change it for the 'luxuries of Egypt,' Dr. Shaw remarks:—

"Some such feeling as that seems to be permanently retained by almost all who have ever engaged in community life. It is a notable fact that many of these people who have enlisted in the work of human amelioration have their wits wonderfully quickened thereby, while the one-sidedness of their development tends to deepen and confirm opinions once received. The ill-fated colonies of Robert Owen had passed into the history of 'extinct socialisms' a generation ago; and yet the writer himself might designate one and another and another of the now venerable associates of Owen, still fresh with enthusiasm, and warm with sympathy, for every proposed social reform. The last of the Fourierist phalansteries disappeared before the war; but many of the men who were engaged in them may still be found wrestling with the problems of co-operation, or pounding away at something more radical. Icaria once numbered its hundreds of disciples. Most of them have disappeared, seemingly swallowed up in the mass of American society; but, if the truth could be ascertained, they would, in all probability, still be found to be communists at heart" (pp. 176, 177).

A second lesson which Icaria teaches, is that the difficulties in the way of a realization of communism have existed largely in the imperfections of human nature. Attempts to erect a social fabric of a new design have shattered, because the building-material was not strong enough to resist the strain to which it was subjected. It is a sweet thing for brethren to dwell together in unity, but truly a most difficult thing. While in Nauvoo, Ill., their first settlement, Cabet early leads one party of Icarians in violent attacks on an opposite party; and the controversy waxes warm and bitter, until a disastrous split separates the two sections permanently. Cabet dies poor and broken-hearted in St. Louis, his adherents are soon scattered, while his opponents found a new settlement in Iowa. But these latter, united in poverty and trial, are unable to endure prosperity; and a young and progressive party, unwilling to accede to the policy of their more conservative elders, effect a separation. Peace and prosperity have never remained long with the Icarians, but they have never ceased to persevere in hope of better things.

One of the most interesting and at the same time touching passages in Dr. Shaw's book is that which describes the beginning of a system

of private property, and the relentlessness with which it was suppressed as soon as discovered. It appears that the privilege had been granted each family of cultivating a small plot of ground surrounding the house, in such manner as the members thereof thought good: this was the origin of the question of the 'little gardens' ('*les petits jardins*').

"Everywhere else in the community the Icarian motto (all for each, each for all) was the invariable rule. If, in the one matter of these tiny plots environing their humble domiciles, the Icarians allowed the idea of '*meum et tuum*' insidiously to enter, and if they found a keener enjoyment in the flowers or the grapes because of the forbidden but delicious sense of ownership, we must not condemn them too harshly, nor impeach their communism. There was something noble and pathetic in the manner with which these 'citoyens' and 'citoyennes' put away the accursed thing when they awoke to a realization of the fact that the gardens were introducing a dangerous element of individualism and inequality" (p. 101).

This unpretentious little book on Icaria may be commended as a contribution to social science well worthy of careful perusal. It may be proper to state, in conclusion, that the book was presented by its author to the authorities of the Johns Hopkins university as a thesis for the degree of Ph.D.

THE PHYSIOLOGICAL ANATOMY OF PLANTS.

THIS is the best sketch of plant-life that we have seen. The author criticises Sachs's view that the cell is merely passive, and shows that we must recognize both the separate individuality of the cell and the corporate unity of the complex plant, though in the higher plants the independence of the cell is largely subordinated to the general weal. He also rejects Sachs's 'Fundamental system' of tissues as being a heterogeneous assemblage, and as in no sense a physiological unity. The right classification of tissues is shown to depend neither on embryology (for mature tissues show no embryological unity) nor on collocation (whether outside or inside the thickening ring), but on their actual structure as related to their functions. Thus the tissues are arranged as protective and nutritive,—the protective including dermal and skeletal (or mechanical) systems; and the nutritive including absorbing, assimilating, conducting, storing, respiratory, and secreting organs. The bulk of the book is occupied with the anatomy of the plant as dependent on its functions.

Physiologische pflanzenanatomie, im grundriss dargestellt. Von Dr. G. HABERLANDT. Leipzig, Engelmann, 1884. 12+398 p., illustr. 8°.

Under the protective system, we learn that cork and cuticle are a kind of fat, like tallow; the cork being impermeable to changes of temperature, and so securing slowness of freezing and thawing. The special secretions of ethereal oils have also been found by Tyndall to be useful in preventing the escape of warmth by night, and over-heating by day.

The mechanical system includes bast, wood-cells, and sclerenchyme; some parts resisting pulling forces, others resisting pressure. The bast-fibres of many plants surpass iron, and in some cases even steel of equal cross-section, in their power of bearing weights. Before winter the walls of the bast may thicken, becoming collenchyme, and the walls of cambium-cells may also thicken, as a means in both cases of storing food which is given back in spring. As a general rule, stems are strengthened to resist pressure, and roots are fortified against injury by pulling; and hence the circular arrangement of mechanical elements in the one case, and their axial situation in the other. But stems growing in water, and aerial roots, reverse the conditions, and accordingly the structure; so that we come to have root-like stems and also stem-like roots. The venation of leaves is directed to protect them from injury, and sometimes to roll them up, and so minimize evaporation. Some leaves in arid regions have 'water tissue,' with large reservoirs of water for times of drought.

Root-hairs are subsidiary to the surface of the young rootlets for absorbing water, and may occur on underground stems. They abound most in plants inhabiting dry places and in those which transpire freely; and are absent from Coniferae (whose transpiration is low) and from marsh-plants (where the water-supply is abundant).

The special assimilating organs are the palisade-cells of the leaves, the sponge-cells being only subsidiary. But the sponge-cells are important for transpiration; and in beech-trees the leaves in sunshine have much palisade-tissue, whilst those in shade have most sponge-tissue.

On the conducting system (*leitungssystem*) our author makes a wide, and we think a justifiable, departure from current doctrines. According to Sachs, the vessels of plants contain air, and the wood-cells carry water in the substance of their walls (we understand that Sachs has given up this view). Haberlandt shows that the water in the cell-walls is probably fixed as if crystallized; that the spring wood conducts water rapidly, though it is thin-walled; that water has been shown by Höhnell

to be in the vessels; that in palms and tree-ferns there is too little prosenchyme to satisfy Sachs's doctrine; and that Sachs's experiments were defective and wrongly interpreted. The wood-cells are merely mechanical, and the water ascends through the vessels and tracheids.

Though the vessels may contain air-bubbles, they do not communicate with intercellular spaces or with stomata, and the low tension of the air in them would favor a suction rather than a supplying function. They have water both by day and night. The air appears in them when the day is somewhat advanced; and the alternate bubbles of water and air, like Jamin's tubes, favors Elfving's view of the ascent of the water by 'steps' (as a writer in *Nature* names it). The transverse walls of some vessels (as tracheids) support starch, which is too heavy for fluids; and the thin membranes permit the slow passage of water, but stop the passage of air. In pitted cells or pitted tracheids the diffusion surfaces are enlarged at the pits without the walls being weakened. The wide ducts of rattans afford quick passage for water by diminishing adhesion; whilst water-plants have few closed ducts. The long vessels are for through passage of water, and abound in stems; but tracheids are for local supply, and predominate in leaves of phanerogams and in some cryptogams.

Another part of the conducting system is the conducting parenchyme of the leaves and stem, including the parenchyme of the fibro-vascular bundles, the medullary rays, and the transparent parenchyme around the bundles of the leaves. These cells convey or store carbohydrates, as starch and sugar. Their proximity to the vessels indicates osmotic action, by which water and substances in solution pass out and in; the conducting tissue aids in the transmission of water; and the vessels may aid in the transference or storing of carbohydrates. The conducting parenchyme of the wood-region joins neighboring medullary rays, the contents of which can pass radially in the stem.

The conducting system for the proteids is the cambiform cells and the sieve-tubes, the perforations of the latter permitting the transmission of undissolved substances. Milk-ducts share in the functions of the sieve-tubes, reaching even to the base of the palisade-cells of leaves, and being abundant when the sieve-tubes are few.

The passage of air is by the intercellular spaces. Carbon dioxide can penetrate the cuticle; and both stomata and lenticels can open and close so as to regulate the supply. The stomata of plants inhabiting arid regions are

kept permanently closed, or are protected by ante-chambers; and those of some marsh-plants cannot close at all. In sunny places the air in the intercellular spaces is in motion, and may be observed passing out by the stomata. During the life of the plant, two maxima of transpiration occur: (1) in youth, the air passing through the soft cuticle; (2) in adult life, when it passes by the stomata.

The suggestion of Sachs, that the narrowness of the cells of autumn wood of trees results from tension, is unsatisfactory, because the change from broad to narrow cells is sudden, and the tension upon the young wood is nearly the same in autumn as in spring. How the difference is caused is not known; but it benefits the tree by affording wide channels for a plentiful supply of water for the opening leaves of spring and for the excessive transpiration of summer, and, on the other hand, by providing thickness and strength to meet the stress of winter.

G. MACLOSKE.

TROWBRIDGE'S PHYSICS.

ALL who are interested in the improvement of elementary science-teaching must regard with no little interest the announcement that a physicist of Professor Trowbridge's deservedly high reputation and great experience has taken time to prepare a text-book in physics for secondary schools. 'The new physics' is certainly not of the common type of text-books, and it will be generally welcomed as, in many respects, a new departure.

Exercises in measurement occur from the beginning, and the student is shown the importance of 'finding out things for himself' at an early stage. The book is rich in suggestions concerning the construction and use of simple forms of apparatus, by means of which important physical constants may be determined with some precision. For linear measurement such instruments as the vernier, the spherometer, the cathetometer, and the microscope with cobweb micrometer eye-piece, which are often among the more expensive appliances of a physical laboratory, are described, and their construction so planned as to tempt any enterprising high-school teacher to undertake their manufacture. Several ingenious methods of measuring small intervals of time are introduced, and most of them are so simple that their value can be tested at little expense. By means of these methods the laws of motion are investigated experimentally: in fact, the

attempt is made to discover what these laws are, and not merely to verify them. The student is taught how to construct galvanometers and electrometers, and how to use them in electrical measurement. In short, what may be termed the laboratory method of teaching elementary physics is adopted by the author without reserve.

But it is a great disappointment to find a book containing so much that is fresh and original so marred by errors, many of which are really serious. The laudable attempt has been made to put the student in possession of certain principles of prime importance which are generally to be found only in the college text-book, and not always there. In the discussion of some of these, mistakes of considerable magnitude, and statements that are very misleading, have unfortunately found their way into the text. Of these, some of the most serious are to be found in the chapter on moments of inertia. In attempting to calculate, without involving the element of time, the force with which a steel spring strikes a pendulum ball, some inconsistent and extraordinary equations are produced. A little further on the reader will be astonished to find it demonstrated (?) that in a lever the products of each force by the *square* of its distance from the fulcrum are equal; and on this proposition the principle of moments of inertia is allowed to rest. The statement is also made that the radius of gyration is the length of the equivalent simple pendulum; and this error permeates the whole treatment of simple and compound pendulums. In the definition and discussion of equipotential surfaces the false assumption is made that force is constant over such a surface. Preliminary to the consideration of the work done by an electric current will be found a brief discussion of the dimensions of force and work, which is obscure and misleading.

There will be considerable difference of opinion about the propriety of inserting in an elementary text-book such matter as the determination of the value of the ohm in absolute units, the measure of the horizontal component of the earth's magnetism, and the measure of electromotive force by the 'throw' of a galvanometer-needle.

The book is extremely suggestive, and will be found of great use in the hands of the enthusiastic teacher. A second edition will doubtless be free from the numerous mistakes of the present, which can hardly be regarded as a safe guide to one not already tolerably familiar with the underlying principles of the 'new physics.'

NOTES AND NEWS.

A NOVEL event transpired at Boston last Wednesday, in the celebration, by Dr. B. Joy Jeffries and his friends, of the centennial of the first balloon voyage ever made across the English Channel, which was undertaken by his grandfather, Dr. John Jeffries, on Jan. 7, 1785. In this connection, Dr. Jeffries has happily printed, in the current number of the *Magazine of American history*, the original diary of Dr. John Jeffries, illustrated by three excellent portraits, one representing him as taking his voyage. The account of the trip is exceedingly interesting, and told in very simple language. But many persons would doubtless be more attracted by the naïve account of his reception in Paris, and the honors which he received during his six weeks' residence there. It gives a vivid picture of society, at the time, in that gay capital.

—A party of German explorers, consisting of Dr. Karl von den Steinen, Wilhelm von den Steinen, and Otto Klaus, has just reached Rio de Janeiro, after a journey of five months through the least-known part of Brazil. Starting from Cuyaba, capital of the province of Matto Grosso, in May, these gentlemen went by land to one of the head waters of the Xingú, — to which they gave the name of Batovy, in honor of the president of Matto Grosso, who furnished an escort, and in other ways aided the expedition, — and, embarking upon this stream in bark canoes made for the purpose, reached the mouth of the Xingú in October. The journey was rendered dangerous by the innumerable rapids of the river, and by numerous tribes of Indians who had never before seen a white man, but was safely accomplished without a single serious accident. The results promise to be of great geographical and ethnological interest. The Xingú, which is thus added to the small number of Brazilian rivers that have been accurately explored and mapped, has been the least known of all the great rivers of the empire; and its valley has become the centre of the unknown Indian country from the driving-in of the more intractable tribes by the advance of civilization along the Tocantins, Tapajos, and Upper Paraguay. Its lower course was explored in 1842 by Prince Adelbert of Prussia, to a point above the great bend; but the upper course has only been known from the somewhat vague accounts of missionaries and traders of colonial times, which have, until recently, been overlooked by Brazilian geographers. Represented with tolerable accuracy on the earlier maps, it has, during the last thirty or forty years, been a sort of geographical shuttlecock, each succeeding map introducing some erroneous correction. An important stream, the Paranatinga, an affluent of the São Manoel, branch of the Tapajos, or perhaps the upper course of that river, was first transferred to the Xingú. When this mistake was discovered, through a consultation of ancient documents, another was committed by taking three or four degrees from the length of the Xingú on the supposition that there was not room for its source near the parallel of 15° south, between the Paranatinga and the Araguaya. The present ex-

plorers report that the river flows through a fine country very abundant in rubber, but that it is too much obstructed by rapids to become a commercial highway.

—Agricultural experiments continue at Houghton farm (Mountainville, Orange county, N.Y.), on the general plan adopted in 1879, but with some extension and modifications. In the line of agriculture proper, the chief work is the comprehensive study of the Indian-corn plant, and experiments in rotation of crops, as inaugurated by Dr. M. Miles. Ten acres are devoted to this branch. One report has been published, and another is in preparation. The experiment-orchard planted by Professor Penhallow, and covering three acres, is doing finely, and promises results of value to horticultural interests. Meteorological observations are carried on, — atmospheric, surface, and subterranean temperatures receiving especial attention, — and an annual report is printed. In this department, instruments have been lately installed to secure continuous records. It is so difficult to thoroughly provide for animal experiments, that these have been undertaken only in a somewhat desultory way. Miscellaneous investigations, all related to practical farming, are carried on as time and circumstances permit. It is understood that Mr. Valentine is in search of the right man, with scientific training, faculty for original research, and taste for farm-life, to take the immediate charge of the experiment department at Houghton farm. The time of Major Alvord, general manager, is so occupied, that he can only give the work of this department a general supervision.

—W. Köppen, editor of the *Meteorologische Zeitschrift*, has published, according to *Petermann's Mittheilungen*, a chart of the zones of temperature from a new point of view, having taken as a divisional mark the length of the hot seasons according to their real relations, without reducing them to an ideal average. The tropical zone embraces those regions in which all the months are hot, that is, have a temperature of 30° C; the subtropical, those in which, during from four to eleven months, the mercury reaches that point. The temperate zone, with from four to twelve months in which the ruling temperature is from 10° C. to 20° C., he divided into regions which are marked by a uniformly temperate climate, those in which the summers are hot, and those with a moderate summer and cold winter. The frigid zone contains only regions with but from one to four months of moderate temperature; the polar circles, those where in no month does the mercury reach 10° C. In addition, there is shown on the chart the boundary of the northern ice-field, the isothermal line of 10° C., and the boundary of the four months' cold (under 20° C.) In the accompanying explanation, Mr. Köppen points out the influence of temperature upon the organic world, — shows that the boundaries taken by him very often agree with those of distribution of animal and plant life.

—Dr. Lacerda of Rio Janeiro, who has for some years been investigating the subject of snake-bites, now states that the poison of other snakes does not

differ in its effects from that of the rattlesnake, a view also maintained by Dr. Mitchell. The cure by means of injecting permanganate of soda into the bite has been subjected to further experiments by Dr. Lacerda. These prove that the injection must be fresh, and done immediately, and would be of no avail if the bite had penetrated an artery; also the injection must be made frequently, and all round the bite. He has already cured several cases of snake-bite thereby.

—The Russian geographical society has received a report from its member, M. A. V. Adrianof, who is travelling in the Altai and Sayan ranges. After traversing the Shapshalka Pass, he followed the course of the river Kemtsik, a branch or tributary of the Ulu Kem. In these regions he met with only a few Russian traders, but found a colony of Russian dissenters, who settled near the Chinese frontier in the time of the Patriarch Nikon, and placed the whole of their joint property under the uncontrolled administration of their leader, forming themselves into a kind of commune. Their occupations are agriculture and hunting. The native population which surround them manufacture a sort of felt, and have learned to weave a tissue of wild hemp. They prepare an intoxicating drink from milk, which they consume in notable quantity. These peoples who live in the basin of the river Kemtsik are Sayanians, or Sayantsi. They display a remarkable capacity for mixing with neighboring races without being merged, — a process which, however, succeeds better with Turanian and Finnic than with Mongolian tribes. There exist some important and interesting monuments of the past among these Sayanians, who are also known under the appellation 'Tuiba,' in their burying-places. These are either marked by conical cairns, or are flat areas surrounded by a circular row of stones, which are sometimes plain, but often covered with figures and inscriptions, and bear in some instances rude representations of the human figure. Remains of sacrifices, generally of a horse, are found near the tombs.

—The Russian explorer, Col. Prjevalski, spent last summer in exploring the plateau lakes of Thibet. The height of those at the source of the Yellow River he estimates at 13,500 feet, and those of the plateau at a thousand feet more. The climate he describes as detestable, cold, snow or rain, the whole summer through. The quantity of rainfall brought from the Indian Ocean by the south-west monsoon is so great that all summer the north of Thibet is one great swamp. Fish and quadrupeds are numerous, birds rare, the flora poor but peculiar. Prjevalski's party was twice attacked by robbers, whom they successfully repulsed. He means to continue his explorations.

—About ten per cent of the plants collected in the north-western Mexican states by recent collectors prove to be new species.

—Prof. David S. Jordan has been appointed president of the Indiana university.

—J. Müller, a German mining engineer, has applied electrolysis to the rectification of light coins. The

practice obtains of reducing the weight of over-heavy coins by dissolving off some of the metal with acid; but in Germany, at least, no attempt has hitherto been made to add metal to the coin by electro-deposition in order to bring it up to its proper weight. The method answers well for small losses of weight, because the metal added in that case does not deface the characters on the coin.

—The *Athenaeum* states that the government of Siam is about to take steps for the opening of the interior of its fertile territory. With this object, an expedition for survey and exploration will shortly set out for Kabin, where there are said to be mines of considerable value. The idea is to connect this place with Bangkok by a railway, which would be ultimately carried on to Karat, Sohai, and Phitsalok. By this means Zimmay and the fertile region of Laos would be brought within convenient distance of the sea.

—The naturalist, Groum Grzhimailo, has returned from eastern Turkestan, where, during the past spring and summer, his expedition was mainly employed in investigating the zoölogy of the country. He has collected seventeen thousand specimens of lepidopterous insects, of which a large number are of hitherto unknown species. The altitudes of many mountains were taken, and thermometrical readings registered throughout the journey. The general observations of Grzhimailo tend towards an affirmative solution of the contested question of a glacial period in central Asia. He reports the existence, on Thian-Shan Mountain, of forms which up to now had been found only in North America, Lapland, and the Swiss Alps. This explorer proposes to start next year from Samarkand in order to pursue his researches on the western spurs of the Thian-Shan range, which have not as yet been the object of zoölogical investigation.

—Mr. Edwin Guthrie has published a pamphlet on the development of the art of numeration, in which he has brought together in a condensed form a very considerable amount of information on a most interesting subject. The pamphlet includes a table of the Assyrian, Egyptian, Hebrew, Greek, Roman, and Arabic systems of notation.

—The ninth volume of the *Ornithologist and oölogist* forms a large octavo volume of a hundred and fifty-two pages, and, as regards both quality of matter and literary execution, is greatly superior to any of its predecessors. It consists wholly of original matter, and contains very little trash, and a large amount of valuable information, particularly about the nesting-habits of little-known species. It is carefully printed on heavy paper, is creditable to its new publisher and editor, and has a fair claim upon the attention of the ornithologist as well as the non-scientific bird-lover.

—Clermont Gannéau is publishing a book entitled 'Les fraudes archéologiques en Palestine' (Paris, *Ernest Leroux*). This volume, illustrated with numerous engravings, contains a full account of the false Moabite potteries at Berlin, of the celebrated Shapira Deuteronomy, and of different spurious monuments of Palestine and Phoenicia.

—The dean of Clonfert has in the press a work on 'The general principles of the structure of language.' Trübner is the publisher. The work contains grammatical sketches, drawn up with great minuteness, of about a hundred and twenty languages, African, American, Oceanic, Asiatic, and European.

—The latest part (tomo vi. 2, 3) of the bulletin of the National academy of sciences in Cordoba, Argentine Republic, has been received. It contains two geological papers, — the first by Florentino Ameghino, on a series of geological and paleontological excursions made in the province of Buenos Aires; and the second by Adolfo Doering, on certain artesian borings in the Argentine Republic.

—Under the title of 'La rage et les expériences de M. Pasteur,' Gaston Percheron has published an excellent little treatise on hydrophobia (Paris, *Firmin-Didot*). The work gives briefly a clear account of all that is known of the malady, with the latest discoveries of Pasteur respecting the protective vaccination of dogs against rabies, and the confirmatory report of the commission appointed by the French government to control the test experiments. The description of the primary symptoms of the malady in dogs is interesting, and may be useful. The treatise is written in a popular style.

—The *Illustrirte zeitung* gives an account of the exploring of the mysterious little river, Reka, which rises in the Carinthian Alps, disappears, and emerges again in Istria as the Timavo, finally flowing into the Bay of Monfalcone. An exploring party from the village of St. Canzian last March entered the grotto into which the river disappears. For sixty yards the boats went along a narrow channel bordered by walls a hundred metres high; then a cavern was reached, where the party was obliged to land, as the current was too strong for the boat. They followed the left bank of the stream along the rocks until it was only four metres broad, when they crossed it on a plank, then followed the right bank until they came to the sixth subterranean waterfall. The magnesium light showed calm water below this. Four explorers started again on the 9th of November, and reached a seventh waterfall.

—'Danger-lines and river-floods of 1882' is the title of Signal-service note xv., by H. A. Hazen, junior professor in the office of the chief signal-officer. The height at which floods become dangerous is given for forty-seven cities, arranged alphabetically. This is supplemented by special notes descriptive of the conditions of danger at these stations. In accordance with these measures, warnings can be issued as the rivers rise. The excessive floods of 1882 in the Mississippi basin are referred to an unusually early spring, causing a rapid melting of snow, combined with excessive rainfall, which caused simultaneous high water in both the Ohio and Mississippi rivers. The progress of the flood-wave crest down stream is found to occupy from three to eight days (mean, five and seven-tenths) between Cincinnati and Cairo, and from eleven to twenty-four (mean, sixteen and eight-tenths) from Cincinnati to Vicksburg. In general, the higher the

water, the longer is the time of movement. The statement has been made in the flooded district, that, "if the river-banks were now as heavily wooded as in the great flood of 1824, the water would have risen ten feet higher in 1882 than it did." To this Professor Hazen answers, that the same heavily wooded condition of the banks farther up stream would have held back the water, retarded the supply, and thus reduced the height by distributing the flood over a longer period. The value of property lost in the floods of 1882 in Tennessee, Mississippi, Arkansas, and Louisiana, is roughly estimated at nine and a half millions: the loss of life was a hundred and forty-eight.

—The city of Providence, being embarrassed about the disposal of its sewage at the head of a tidal bay, sent two of its engineers to Europe last summer to investigate the various processes practically employed there to accomplish the desired end. The resulting report has been recently issued in an octavo volume of a hundred and fifty pages, with many plates and maps. It contains recommendations to the effect that 'intercepting sewers' should be built so as to catch the sewage just before it flows into the natural channels of drainage, and that it should be thus carried to Field's Point, on the west bank of Providence River, near the southern limit of the city; that it should there be treated by chemicals in such a manner as to clarify it by precipitation of suspended matter; and that the clarified effluent should be emptied into deep water off the point. The estimated cost of this arrangement is over three and a half million dollars. The report contains much material of interest; and Appendix A, on 'sewerage systems and sewage disposal,' which makes the greatest part of the volume, is a valuable historical and practical statement of the question.

—According to a telegram from Calcutta, Mr. Griesbach, the geologist with the Afghan boundary commission, describes the route between Guetta and the Helmund as presenting features very similar to those in the Pishin valley and Candahar; namely, a system of precipitous, deeply eroded ridges, extending from north and south to north-east and south-west. Extensive post-tertiary deposits fill the intervening valleys. The south-west extremity of the Ghazarband range is composed of sandstone shales and grits of the Flysch facies of eocene rocks. A series of low hills and valleys stretches between Canj-pai and Nushki, which, from their composition, appear to be merely continuations of the Kojah Amran range, but near Galiabah the formation is distinctly younger, the epoch being mostly trap rock, which in places bursts through the cretaceous limestone overlying it, and locally converts it into white marble.

—The steamship *British Prince* reports that on Dec. 23, in latitude 40° 45' north, longitude 66° west (about four hundred miles east of New York), from two A.M. to half-past five A.M., she had steady St. Elmo lights at yard-arms and mast-heads. The weather was overcast, dark, and gloomy, with torrents of rain, vivid lightning, and peals of thunder.